

Figure 8.--Calcium concentration

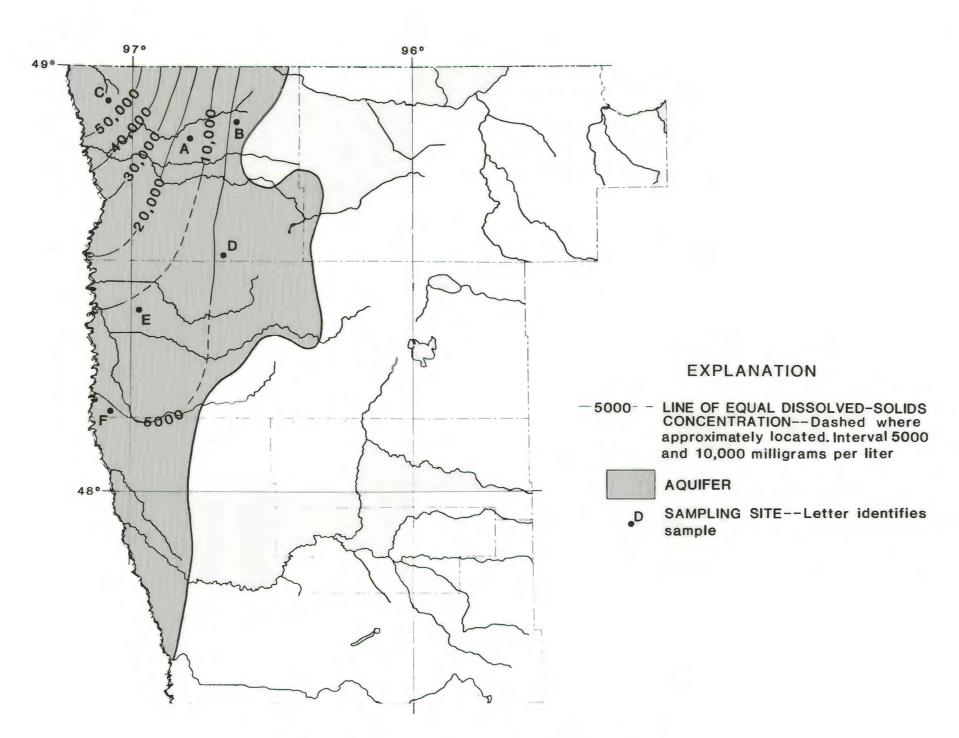


Figure 6.--Dissolved—solids concentration

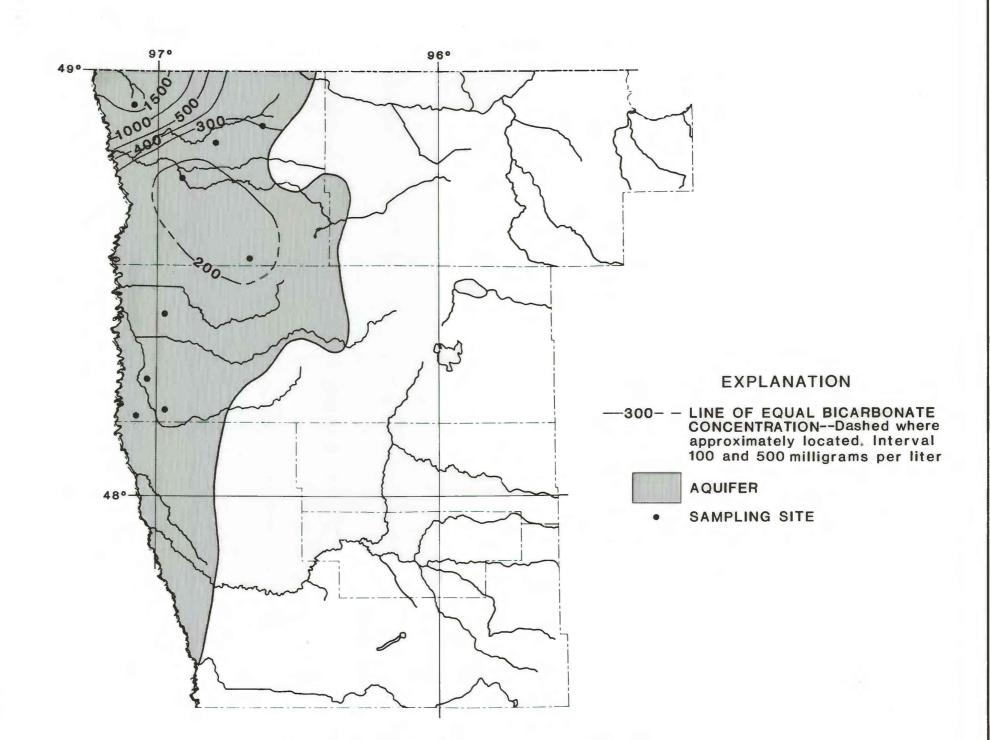


Figure 11.--Bicarbonate concentration

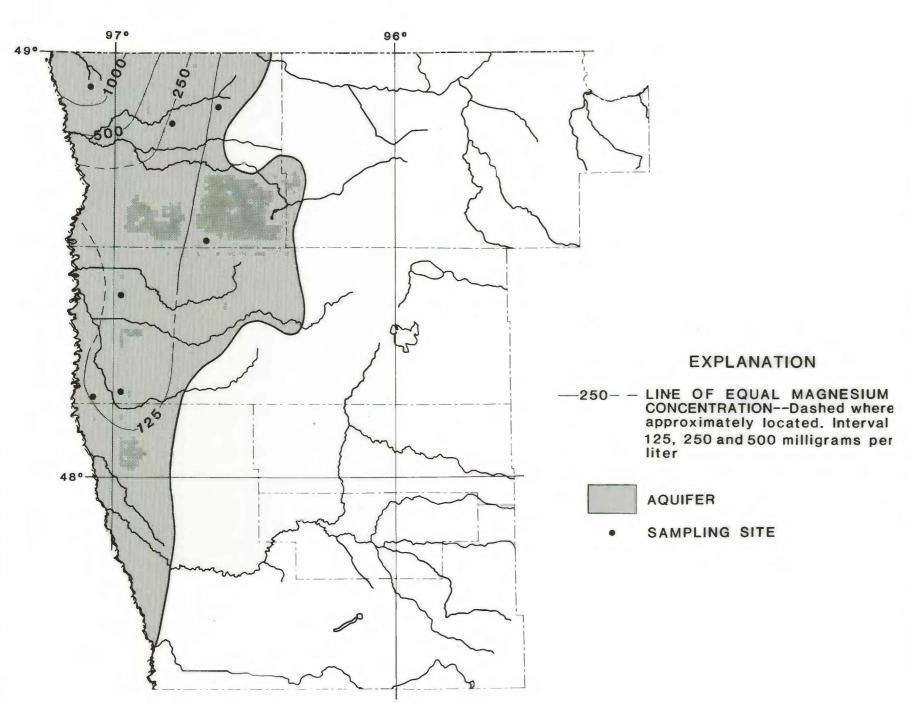


Figure 9.--Magnesium concentration

Dissolved Solids

Dissolved-solids concentration is commonly used as a guideline to assess suitability of water for various uses. A dissolved-solids concentration less than 500 mg/L generally is considered to be satisfactory for domestic and most industrial uses. However, dissolved-solids concentrations in the aquifer range from about 3,000 mg/L in the eastern part to about 60,000 mg/L in the northwest corner of Minnesota (fig.

Major Ions

Water from the Red River-Winnipeg aquifer is predominantly a sodium chloride type (fig. 7). The highly saline water from the aquifer moves upward into parts of the overlying drift (Maclay and Winter, 1967). The major ions generally increase in concentration toward the northwest corner of Minnesota (figs. 8-13).

WATER QUALITY

The quality of water in the Red River-Winnipeg aquifer is considered to be poor because of the high dissolved-mineral content. The eastward movement of highly mineralized water from Ordovician rocks in North Dakota into the aquifer and the high solubility of minerals in the aquifer account for the high salinity (Maclay and Winter, 1967). The water-type diagram and maps showing concentration of dissolved solids and major ions are based on samples collected by the U.S. Geological Survey from about 1952 to 1956, except for one site that was tested in 1932. A summary of representative analyses for selected sites is given in table 2.

Table 2.--Water-quality analyses of samples collected from the Red River-Winnipeg aquifer 1

Values are given in milligrams per liter, unless otherwise indicated: micromhos per centimeter, umhos/cm; microgram per liter, ug/L; a dash indicates a missing value.]

Constituent or property	Well number ²					
	A	В	С	D	E	F
Specific conductance						
(µmhos/cm at 25°C)	19,900	61,200			14,600	6,910
pH (units)	7.2	6.9		-	7.3	7.5
Temperature, water (°C)	9.4					
(Mg. Ca)	2,400	8,040	8,410		1,440	950
Noncarbonate hardness	2,210	7,900	-		1,210	761
Calcium, dissolved (Ca) Magnesium, dissolved	589	2,030		95	296	220
(Mg)	227	723	1,105	54	170	98
Sodium, dissolved (Na) Potassium, dissolved	3,680	13,300	18,490	825	2,680	1,080
(K)	64	223	379	14	45	24
Bicarbonate (HCO3)	237	174	1,820	168	276	230
Sulfate, dissolved						
(SO ₄) Chloride, dissolved	923	2,600	2,390	93	621	500
(C1)	6,650	24,100	32,150	1,450	4,670	1,950
Fluoride, dissolved (F) Silica, dissolved	1.0	1.4		1.5	1.0	0.6
(SiO ₂) Dissolved solids (residue on evaporation at	12	6.9				
180°C)	12,800	47,400	57,220	2,910	9,040	4,240
Nitrate, dissolved (N)		-		0.2	2.9	1.5
Boron, dissolved (B),	3.0	4.7		1.4	3.3	2.8
Iron, dissolved (Fe), µg/L	4.300		9,000	1,600	7,200	990

¹Samples collected from 1950 through 1970. ²Wells plotted on figures 8 through 13.

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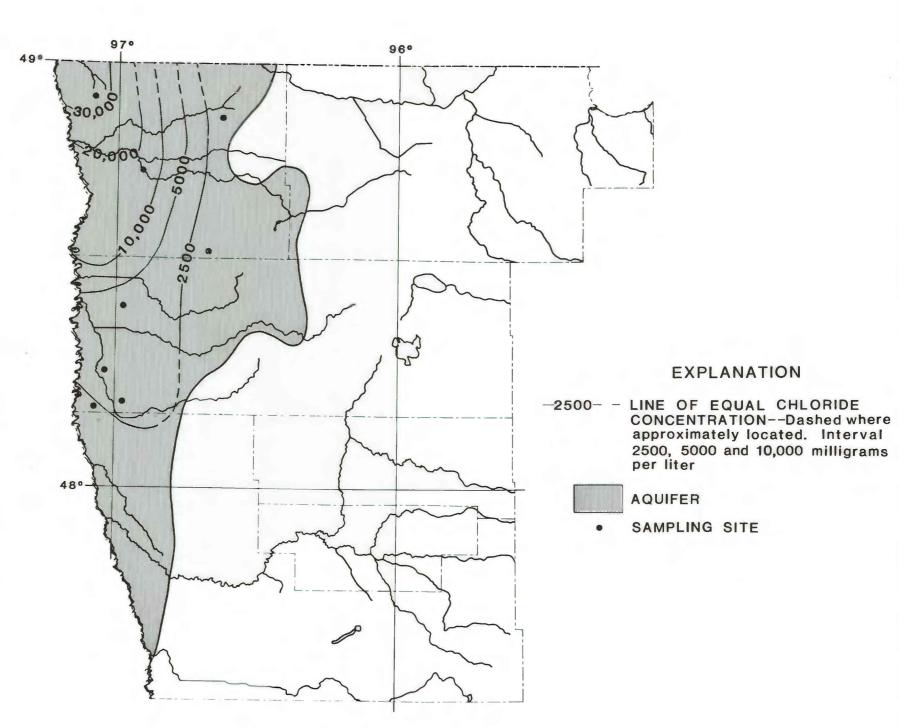


Figure 12.--Chloride concentration

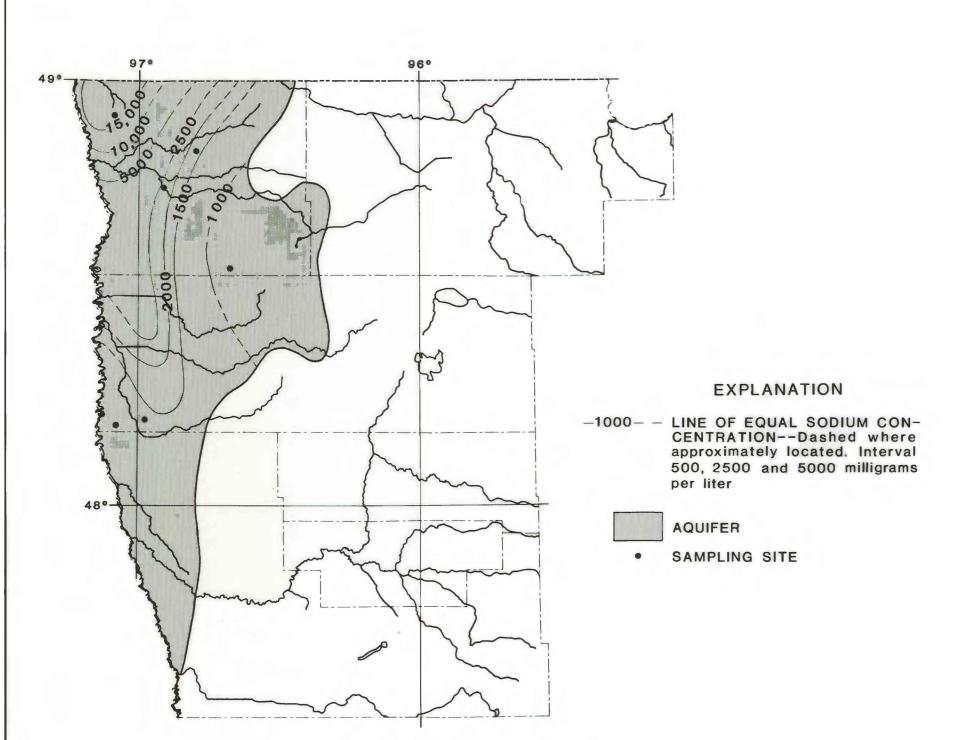


Figure 10.--Sodium concentration

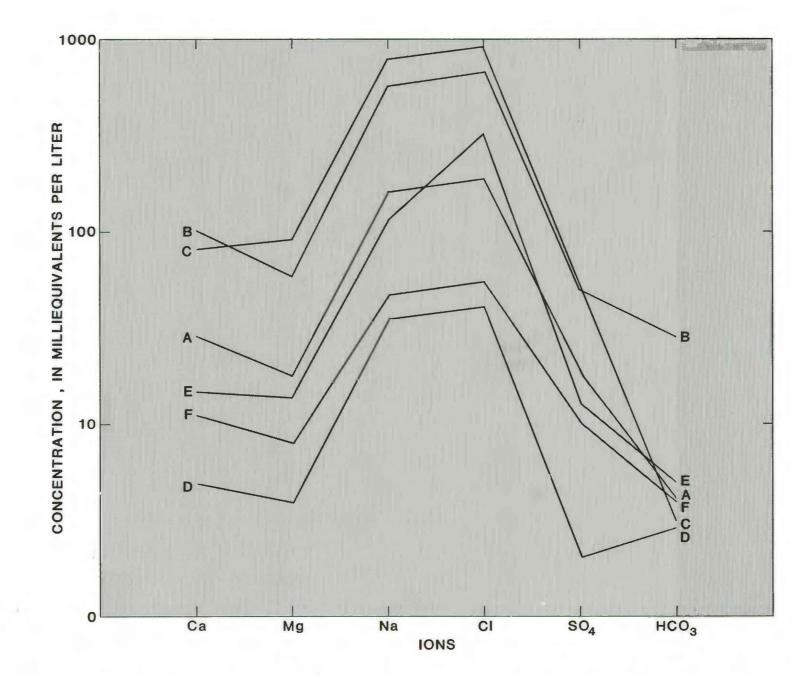


Figure 7.--Water—type patterns for six sites in the Red River—Winnipeg aquifer

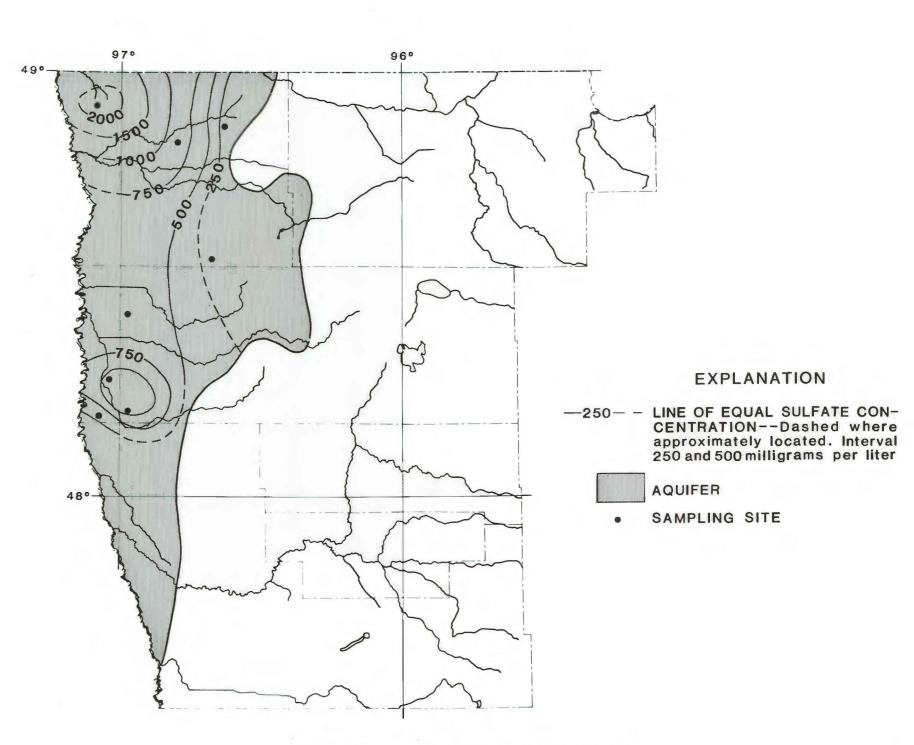


Figure 13.--Sulfate concentration

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HYDROGEOLOGIC AND WATER—QUALITY CHARACTERISTICS OF THE RED RIVER—WINNIPEG AQUIFER, NORTHWESTERN MINNESOTA

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